U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Toxic Hazards

Date: 07/08/2024 **AC No:** 450.139-1
Initiated By: AST-1

This Advisory Circular (AC) provides guidance for an operator to meet requirements defined by Title 14, Code of Federal Regulations (14 CFR) § 450.139, *Toxic hazards for flight* and § 450.187, *Toxic hazards mitigation for ground operations* when using a Federal entity to perform a toxic release hazard analysis (TRHA) or no sufficient amounts of toxic materials exist thus demonstrating non-applicability with the regulation. Launch and reentry license applicants may use this AC to guide their internal processes, format their license applications, or both. This AC provides guidance on the applicability of these requirements.

This AC describes acceptable means for demonstrating compliance where there are no toxic chemicals or where toxic release hazard analysis is performed by an accepted Federal entity. It is intended to assist operators in obtaining a vehicle operator license and operating in compliance with 14 CFR part 450. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. The document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

Note: Because this AC provides guidance for an operator to meet both the requirements defined by Title 14, Code of Federal Regulations (14 CFR) §450.139, *Toxic hazards for flight* and §450.187, *Toxic hazards mitigation for ground operations,* please note there is no AC yet published numbered AC 450.187-1. Please refer to the paragraphs contained within this AC regarding guidance for mitigating toxic hazards for ground operations as well as for flight.

If you have suggestions for improving this AC, you may use the Advisory Circular Feedback form at the end of this AC.

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Contents

Paragraph **Page**

1 Purpose....3
2 Applicability....3
3 Applicable Regulations and Related Documents....4
3.1 Related United States Code Statute....4
3.2 Related FAA Commercial Space Transportation Regulations....4
3.3 Related FAA Advisory Circulars....4
3.4 Related Industry and Government Documents....4
4 Definition of Terms....4
5 Acronyms....5
6 Overview....6
7 Applicability of Regulations....6
7.1 What is Toxic?....6
7.2 Toxicity Thresholds....7
7.3 Exception for Kerosene-based Fuels....7
7.4 Acceptable Method for Identifying Toxic Chemicals....7
8 Means of Compliance Options....9
8.1 No use of toxics, rendering §§ 450.139 and 450.187 inapplicable....9
8.2 Federal Entity Services accepted under § 450.45(b) for §§ 450.139 or 450.187....9
8.3 Exemption under § 450.179(b) for ground safety services provided by a Federal launch or reentry site at its own site....10
8.4 Applicant Performing Toxic Release Hazard Analysis....11

Tables

Number **Page**

Table 1. Criteria for Classifying Materials.... 8

1 PURPOSE

This AC provides guidance for an operator conducting a licensed launch or reentry under 14 CFR part 450. In accordance with §§ 450.139 and 450.187, as applicable, an operator that uses toxic propellants or other toxic chemicals must conduct a toxic release hazard analysis (TRHA), manage the risk of casualties that could arise from exposure to toxic release through toxic containment or a toxic risk assessment, and establish flight commit criteria and ground hazard controls, as applicable, for any necessary evacuation of the public from a toxic hazard area. This current version of this AC discusses only how to identify whether there are toxic materials which is sufficient for demonstrating non-applicability with §§ 450.139 and 450.187 or using a Federal entity to perform a TRHA. A future version will include additional information on performing a TRHA.

1.1 Level of Imperatives.

This AC presents one, but not the only, acceptable means of compliance with the associated regulatory requirements. The FAA will consider other means of compliance that an applicant may elect to present. Throughout this document, the word “must” characterizes statements that directly follow from regulatory text and therefore reflect regulatory mandates. The word “should” describes an option that, if used would constitute a means to comply with the regulation; variation from the provisions of this AC is possible but must satisfy the regulation to constitute a means of compliance. The word “may” describes variations or alternatives allowed within the accepted means of compliance set forth in this AC.

2 APPLICABILITY

2.1 The guidance in this AC is for launch and reentry vehicle applicants and operators required to comply with 14 CFR part 450. The guidance in this AC is also for applicants seeking a vehicle operator license under part 450 and holders of a part 450 license seeking to renew or modify their existing vehicle operator license.

2.2 The material in this AC is advisory in nature and does not constitute a regulation. This guidance is not legally binding in its own right and the FAA will not rely upon this guidance as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with this guidance document (as distinct from existing statutes and regulations) is voluntary only, and nonconformity will not affect rights and obligations under existing statutes and regulations.

2.3 The material in this AC does not change or create any additional regulatory requirements, nor does it authorize changes to, or deviations from, existing regulatory requirements.

3 APPLICABLE REGULATIONS AND RELATED DOCUMENTS.

3.1 Related United States Code Statute.

- Title 51 U.S.C. Subtitle V, Chapter 509.

3.2 Related FAA Commercial Space Transportation Regulations.

The following 14 CFR regulations must be accounted for when showing compliance with 14 CFR §§ 450.139 and 450.187. The full text of these regulations can be downloaded from the U.S. Government Printing Office e-CFR. A paper copy can be ordered from the Government Printing Office, Superintendent of Documents, Attn: New Orders, P.O. Box 371954, Pittsburgh, PA, 15250-7954.

- Section 401.7, *Definitions*.
- Section 450.35, *Means of compliance*.
- Section 450.179, *Ground safety – general.*

3.3 Related FAA Advisory Circulars.

FAA Advisory Circulars are available through the FAA website, http://www.faa.gov.

- AC 413.13-1, *Guidance on Submitting a Complete Application for a Vehicle Operator License*.

3.4 Related Industry and Government Documents.

1. Federal Aviation Administration Office of Environment and Energy, *1050.1F Desk Reference (v4)*, https://www.faa.gov/media/31111, September 2023.
2. National Oceanic and Atmospheric Administration, *CAMEO Chemicals Database of Hazard Materials,* https://cameochemicals.noaa.gov.
3. National Academies of Sciences, Engineering, and Medicine. *Assessment of Exposure-Response Functions for Rocket-Emission Toxicants.* Washington, DC: The National Academies Press, 1998. https://doi.org/10.17226/6205.

4 DEFINITION OF TERMS

The terms from 14 CFR 401.7 apply. There are no additional definitions specific to this AC.

5 ACRONYMS.

AC – Advisory Circular

AEGLs – Acute Exposure Guideline Levels

CAMEO – Computer-Aided Management of Emergency Operations

CFR – Code of Federal Regulations

EPA – U.S. Environmental Protection Agency

ERPGs – Emergency Response Planning Guidelines

FAA – Federal Aviation Administration

OSHA – Occupational Safety and Health Administration

SDSs – Safety Data Sheets

SPEGLs – Short-term Public Emergency Guidance Levels

TRHA – Toxic Release Hazard Analysis

U.S.C – United States Code

6 OVERVIEW.

In accordance with §§ 450.139 and 450.187, an operator must protect the public from toxic hazards associated with its licensed flight and ground operations. This AC provides:

1. Guidance on the applicability of the toxic hazard requirements of §§ 450.139 and 450.187,
2. A means of demonstrating compliance with these regulations in the case where there are no toxic chemicals, and
3. A means of demonstrating compliance with these regulations when services are provided by a Federal entity.

Pursuant to § 450.35(a)(2) and (a)(5), an applicant who elects to perform a toxic release risk assessment must submit their proposed means of compliance with §§ 450.139(e)(1) and 450.187(e)(1) for FAA approval before the FAA can accept their license application for review. Note that, although §§ 450.139 and 450.187 are very similar, an operator must demonstrate an acceptable level of risk to public safety for ground and flight operations as two distinct sets of regulatory requirements.

7 APPLICABILITY OF REGULATIONS.

Sections 450.139 and 450.187 apply to any launch or reentry vehicle, including all vehicle components and payloads that use toxic propellants or other toxic chemicals. An applicant must document use of any toxic propellants or other toxic chemicals, and subsequent determination of applicability or non-applicability of §§ 450.139 and 450.187, per paragraph (a) of each section.

7.1 What is Toxic?

"Toxic" does not have a precise definition, but generally it encompasses all substances that produce meaningful adverse effects to biological organisms due to properties of the substance. This includes chemical interactions, such as corrosive effects, and physical effects, such as fine particulates that are inhalation hazards. It does not include impact effects (i.e. collisions), which are not properties of the substance but of an object. Nor does toxic include transmission of energy through electromagnetic or mechanical (e.g. pressure) waves. Although sometimes radionuclides are considered toxic, in the context of Part 450 they are handled on a case-by-case basis per § 450.45(e)(6) and thus do not need to be considered with respect to §§ 450.139 and 450.187.

7.2 **Toxicity Thresholds**.

In general, it is sufficient to consider only substances that may cause a serious injury or worse to humans due to exposure of less than a few days. Environmental review requirements (§ 450.47) related to toxicity include analysis of hazardous substances from planned events; for more information see Section 7 of Reference 1 in section 3.4 of this document. Residual hazardous materials must be safely disposed of as part of the emergency response plan in accordance with § 450.173(d)(3)(ii), so should have no safety impacts. The standard method for evaluating toxicity is through Acute Exposure Guideline Levels (AEGLs), Emergency Response Planning Guidelines (ERPGs), and Short-term Public Emergency Guidance Levels (SPEGLs). These represent threshold exposure limits (concentrations below which adverse health effects are not likely to occur) for different durations and severity of effects. Evaluation of adverse health effects should consider the most vulnerable foreseeable person that could be exposed.

7.3 **Exception for Kerosene-based Fuels.**

As stated in §§ 450.139(a)(2) and 450.187(a)(2), no toxic release hazard analysis is required for kerosene-based fuels unless the Administrator determines that one is required to protect public safety. Kerosene-based fuels include both jet fuels, such as Jet-A, Jet A-1, Jet-B, and rocket fuels, such as RP-1. Jet fuels are conventionally used in aviation to power gas-turbine aircraft that possess standard airworthiness certificates from the FAA. For this reason, the FAA found that in most cases exempting such kerosene-based fuels from the requirement to perform a toxic release hazard analysis would not have a material effect on public safety. The FAA may require an operator to perform an analysis if the FAA determines that such an analysis is required to protect public safety. For example, the FAA may require an analysis for uses of kerosene-based fuel in systems presenting a novel design or uses that are inconsistent with standard industry practices that may present risk to public safety.

7.4 **Acceptable Method for Identifying Toxic Chemicals.**

The following describes an acceptable method for identifying toxic chemicals. Applicants may also propose alternative methods which the FAA would need to approve.

7.4.1 License applicants should prepare a vehicle bill of materials, which lists every type of material for every vehicle component, including propellants and other chemicals. Applicants should evaluate every material onboard the vehicle using the latest version of the *CAMEO Chemicals Database* (reference 2 in paragraph 3.4). If a substance is not found when searching the *CAMEO* database, then the Safety Data Sheet (SDS)[1] for the substance, as provided by the chemical manufacturer, should be used. Each of these materials should be classified as follows:

[1] See https://www.osha.gov/publications/osha3514.html for the standard for safety data sheets.

Table 1. Criteria for Classifying Materials

Classification	**Criterion**
Kerosene-based fuel	Chemical name: Jet-A, Jet A-1, Jet-B, kerosene, or RP-1
Non-toxic	No AEGLs, ERPGs, or SPEGLs listed in *CAMEO* or Section 11 of the SDS shows no toxicity.
Potentially toxic	*For other than kerosene-based fuels* AEGLs, ERPGs, and/or SPEGLs listed in *CAMEO* or Section 11 of the SDS shows potential toxicity

7.4.2 Likewise, the combustion products of propellants should be evaluated using the guidance in *Assessment of Exposure-Response Functions for Rocket-Emission Toxicants*. (Reference 3 in section 3.4 of this AC).

7.4.3 A bill of materials for every payload is also required from its manufacturer, and the same comparison will be performed prior to the payload arriving at the launch site.

8 MEANS OF COMPLIANCE OPTIONS

8.1 No use of toxics, rendering §§ 450.139 and 450.187 inapplicable.

If a vehicle does not have toxic chemicals, the application must justify this to demonstrate that §§ 450.139 and 450.187 do not apply.

8.1.1 In this case, the application should state:

8.1.1.1 The process described in paragraph 7.3 of AC 450.139-1 has been followed. No materials on the vehicle were determined to be potentially toxic. If after licensure, a potentially toxic chemical is identified in a payload, an application for a license modification will be submitted in accordance with § 450.211. If the proposed launch or reentry will not involve toxic propellants or other toxic materials, then pursuant to § 450.139(a) [or § 450.187(a)], the requirements of § 450.139 [or § 450.187] are inapplicable, as there are no toxic chemicals to report under § 450.139(f)(1) [or § 450.187(f)(1)].

Note: The FAA may require evidence of this analysis from the applicant during its evaluation of the license application or in an inspection post-licensure.

8.2 Federal Entity Services accepted under § 450.45(b) for §§ 450.139 or 450.187.

In accordance with § 450.45(b), the FAA will accept any safety-related launch or reentry service or property provided by a Federal launch or reentry site or other Federal entity by contract, as long as the FAA determines that the launch or reentry services or property provided satisfy this part. Thus, an applicant who proposes to use toxics in their launch or reentry operations may contract with a Federal entity to provide toxic release hazard analyses required by §§ 450.139 and/or 450.187, provided the FAA has accepted the entity's services for these sections. An applicant seeking to rely on services provided by a Federal entity to meet the toxic hazard requirements for flight and/or ground safety must identify in their application the Federal services provided in satisfaction of §§ 450.139 and/or 450.187.

Note: A Federal entity's services may cover only some parts of §§ 450.139 and/or 450.187; the applicant may be responsible for some aspects. The application should be explicit about the role of the Federal entity.

Note: Federal entities often do not perform the release analysis per §§ 450.139(c)(2) or 450.187(c)(2); in the case the application must include a response to §§ 450.139(f)(7) and/or 450.187(f)(7).

8.2.1 If a Federal entity is performing the entire toxic release hazard analysis for flight safety per § 450.139, the application should state:

8.2.1.1 [Entity name] will be performing the toxic release hazard analysis for flight based on data we (the operator) provide on toxic chemicals. We used the process described in paragraph 7.3 of AC 450.139-1 to identify potentially toxic chemicals. The final flight data package will be provided to the Federal entity for each operation that includes the quantities and types of toxic chemicals on the vehicle and any payload(s). [Entity] is a Federal entity whose services have been procured by [Applicant name] to demonstrate compliance with the toxic release hazard requirements of § 450.139 in accordance with § 450.45(b). The results of the toxic release hazard analysis are incorporated into the verification that safety criteria in § 450.101 are satisfied, which is included in the flight commit criteria per § 450.165.

8.2.2 If a Federal entity (other than the launch or reentry site) is performing the entire toxic release hazard analysis for ground operations per § 450.187, the application should state:

8.2.2.1 [Entity name] will be performing the toxic release hazard analysis for ground safety based on data we (the operator) provide on toxic chemicals. We used the process described in paragraph 7.3 of AC 450.139-1 to identify potentially toxic chemicals. Data on toxic chemicals will be provided to the entity for each system prior to arrival at the launch or reentry site according to the requirements of the entity. [Entity] is a Federal entity whose services have been procured by [Applicant name] to demonstrate compliance with the toxic hazard requirements of § 450.187 in accordance with § 450.45(b). The mitigations that result from this analysis, in accordance with § 450.187 (f)(8,9), are incorporated in the ground hazard controls, as discussed in our submission with respect to § 450.189.

Note: During application review, the FAA will review the services provided by the Federal entity to ensure that they satisfy the applicable requirements of §§ 450.139 and/or 450.187 for the operations proposed in the application, in accordance with § 450.45(b). The FAA may also require evidence of the applicant's identification of toxics during application review or during post-licensure inspections.

8.3 **Exemption under § 450.179(b) for ground safety services provided by a Federal launch or reentry site at its own site**.

In accordance with § 450.179(b) and (c), an operator is not required to comply with the ground safety requirements in §§ 450.181 through 450.189, including the toxic hazard requirements of § 450.187, if (1) the launch or reentry is being conducted from a Federal launch or reentry site; (2) the operator has a written agreement with the Federal site for the provision of ground safety services and oversight; and (3) the Administrator has determined that the Federal launch or reentry site's ground safety

processes, requirements, and oversight are not inconsistent with the Secretary's statutory authority over commercial space activities. An applicant seeking to avail themselves of the exception in § 450.179(b) must provide the agreement described in § 450.179(b)(2).

8.3.1 If an applicant seeks exemption from the toxic hazard requirements for ground operations (§ 450.187) at a Federal launch or reentry site, the application should state:

8.3.1.1 [Site name] is a Federal launch [or reentry] site that is providing ground safety services and oversight in accordance with § 450.179(b). As such, [Applicant] submits that § 450.187 does not apply to this license.

8.4 **Applicant Performing Toxic Release Hazard Analysis**.

An applicant may also perform their own toxic release hazard analysis for ground or flight (or both) that satisfies all the requirements of §§ 450.139 and/or 450.187. In this scenario, the applicant should identify any toxics in the manner described in paragraph 7.3 of AC 450.139-1, conduct a toxic release hazard analysis in accordance with §§ 450.139(c) and/or 450.187(c), manage the risk of casualties that could arise from toxic release exposure by performing containment (per §§ 450.139(d) and/or 450.187(d)) or a toxic release risk assessment in accordance with §§ 450.139(e) and/or 450.187(e). A description of the means of compliance for the regulation and all application requirements in §§ 450.139(f) and/or 450.187(f) must be provided.

8.4.1 Applicants electing to perform a toxic release risk assessment (in lieu of containment) in accordance with §§ 450.139(e)(1) and 450.187(e)(1) are advised that the Administrator has accepted the following airborne toxic concentration and duration thresholds for toxic release risk assessment:

- Acute Exposure Guideline Level 2 (AEGL-2),
- Emergency Response Planning Guidelines Level 2 (ERPG-2), or
- Short-term Public Emergency Guidance Level (SPEGL).

These can be found for specific substances in the *CAMEO Chemicals Database*. (Reference 2 in section 3.4 of this AC). Applicants may also develop their own means of complying with the requirements in §§ 450.139(e)(1) and 450.187(e)(1). However, pursuant to § 450.35(a), any alternative means of complying with §§ 450.139(e)(1) or 450.187(e)(1) must be accepted by the Administrator prior to application acceptance.

8.4.2 At this time, the FAA is not aware of any applicant desiring to assess toxic hazards on their own, except through the provision of services from a Federal Entity. The FAA will provide more detailed guidance on demonstrating compliance with §§ 450.139 and 450.187 in a future revision of this AC.

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